

Measuring Broadband AUSTRALIA

Video Streaming & Video Conferencing

This report is the second report to track the performance of NBN broadband services in providing access to video streaming and conferencing applications. Access to video conferencing applications has been critical for many Australians during COVID-19 as students and workers switched to learning and schooling from home. Australians also turned to video streaming services in greater numbers as a result of pandemic related social distancing measures.

The first report showed performance in the month of May 2020, when various mitigations were in place to manage the potential impact of COVID-19 on network and application performance. The principal mitigations were:

- NBN Co's temporary provision of an additional 40 per cent connectivity virtual circuit (CVC) capacity for retail service providers (RSPs) and
- A voluntary reduction in video bitrates by key video streaming and conferencing services.

This second report focuses on performance during mid-September and mid-October 2020. Major over the top (OTT) video streaming services returned to full streaming bitrates in the last two weeks of September as COVID-19 restrictions eased in Australia, with most other OTT video streaming services returning to full bitrates during October 2020. Many OTT video conferencing services continued with voluntary bitrate reduction measures in place throughout October 2020.



Methodology Review*

The presented charts are based on test data that was recorded by SamKnows Whiteboxes hosted by Measuring Broadband Australia volunteers. Data was collected during mid-September and mid-October 2020, with baseline data drawn from February 2020. All collected data concerns test communications that were initiated by the Whitebox while no consumer traffic were present.

Results are presented using a number of splits including by RSP, access technology, state and plan speed and for video conferencing whether the servers are hosted domestically or internationally. Results were recorded across all hours of the day.

All charts use a consistent set of Whiteboxes across the entire test period relevant to the chart. For example, if a Whitebox is included on day 1, this means it generated results for every day in the relevant time range. Conversely, if a Whitebox was offline for one day, then it is excluded for the entire period. Additionally, if a Whitebox changed RSP during the period, it is excluded. All Whiteboxes that met these requirements have been included in the study, including any that are connected to impaired NBN broadband services. Impaired services are those where NBN Co provides us with the information that maximum plan speed cannot be attained due to physical limitations.

*Video streaming test: <https://samknows.com/technology/tests/video-streaming>

Video conferencing test: <https://samknows.com/technology/tests/video-conferencing>

Video Streaming

For streaming services, a comparison is made with a baseline calculated from data drawn from February 2020. Therefore, results presented for video streaming show the net change of September/October 2020 results as compared against the February 2020 baseline. There have been no absolute results presented in this report and as such results shown for RSPs are not comparable against each other; the charts instead show the percentage change for each RSP based on their own prior results from February 2020.

Explicitly, this report does not provide a comparison of RSPs. To ensure comparability with the baseline, the September/October data have been weighted to match the distributions in the February baseline data. For the overall comparisons, the data have been weighted by plan, technology and state. For subgroup comparisons (e.g. by RSP), the data have been weighted by plan only.

Video conferencing

For this report NBN broadband service performance has been tested to a sample of applications to cover a range of use cases, and to illustrate important drivers of the results obtained where possible.

Since issuing the first report, enhancements to the video conferencing tests have been implemented. This report now includes data from paid accounts as well as free accounts where applicable. The type of account used is one of the factors that can affect application performance, as it may mean a video conference is hosted from a domestic rather than an international server. Other factors that could also impact application performance include where the account is created and the overall demand at the time, depending upon the application.

It is important to note that for the test measures of latency to these servers used by these providers, there are other factors that can impact video conferencing performance that are not measured by this test. SamKnows continually works on expanding the metrics captured by tests run in the Measuring Broadband Australia program.

Video Streaming services



Video Streaming services

Streaming service performance is presented for Netflix and YouTube using the percentage change in download speed in megabits per second (Mbps).

Download speed is the most appropriate metric to assess video streaming performance. This is because video streaming services typically download data in large batches, and buffer video in advance (to allow for erratic or unstable internet connections). It is therefore also important to download from the real video content servers, which is what the Whiteboxes do.

All results here show the percentage change in performance compared to a baseline of February 2020 and not absolute results. The results between RSPs are not comparable as what has been reported is the net change from each respective RSP's own previous February 2020 results. Data is provided from 13th September to 12th October 2020.

Average daily and hourly net change figures are presented.

During the analysis, it was found that streaming results for MyRepublic showed a significant deviation in performance during busy hours for streaming services compared to the February baseline. This issue stems from the choice of base period and does not indicate any issue with the testing infrastructure or the RSP during the reporting period. Results for MyRepublic have been excluded from the overall charts presented so as to not have an undue impact on conclusions for the wider network.

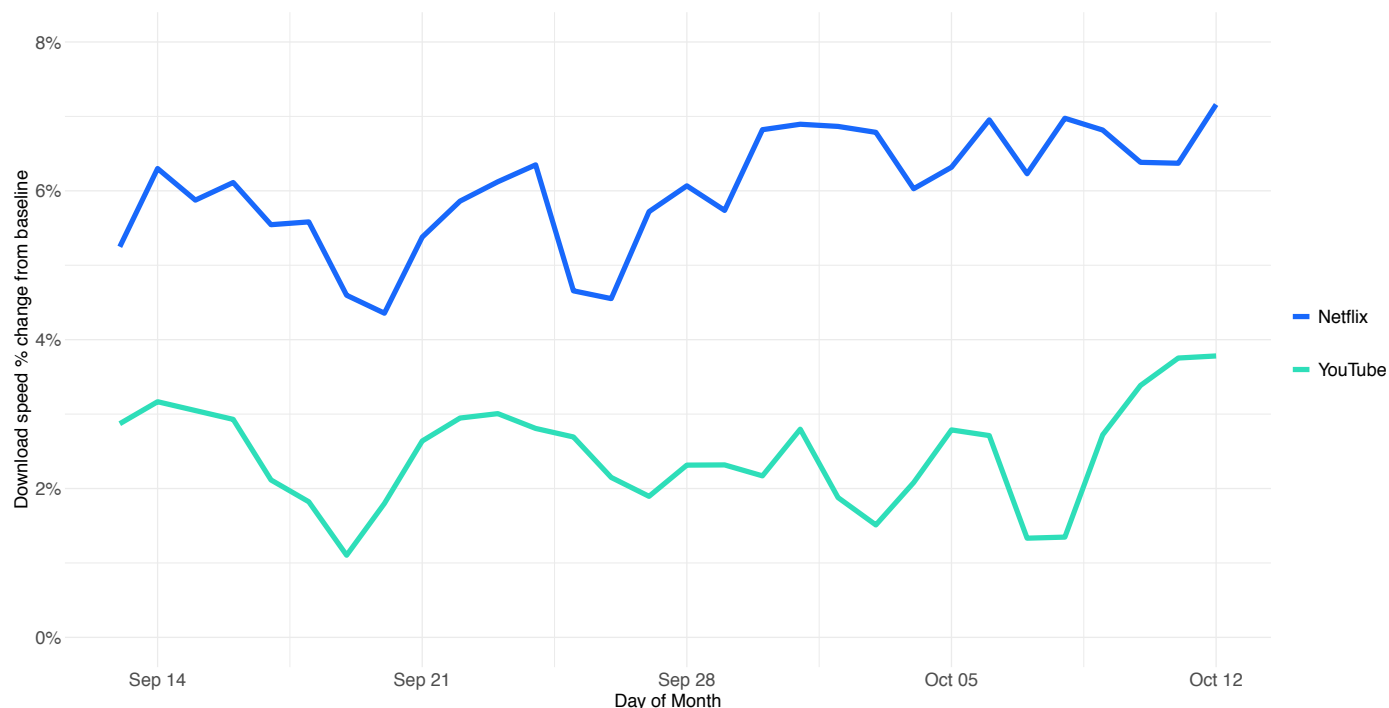
Between the baseline and reporting periods, overall download speeds across the NBN network have seen a significant uplift. A key reason for this increase is the measures introduced by NBN in response to increased demand and change in usage of online applications due to COVID-19. NBN Co has:

- Provisioned more CVC (connectivity virtual circuit) capacity for RSPs. This additional capacity was available to RSPs during the test period for this report.
- Over-provisioned the download component of some NBN speed tiers by around 10 – 15 per cent where possible.

The over-provisioning of the download component now means that consumers can more reliably experience speeds that are closer to the maximum set download speed of their chosen retail plan speed. For example: prior to this change, an NBN100 service would have been provisioned at slightly above 100 Mbps plan speed; after protocol overhead, the highest speed test result which we could have measured might have been around 94 Mbps. After the change, the same service might have been provisioned at above 100 Mbps plan speed, meaning that even after protocol overhead we might still measure speeds around or slightly above 100 Mbps. The increase in CVC has meant that there is sufficient capacity for RSPs to deliver these speeds that are very close to the maximum set download speed. The impact of these measures can be seen in all subsequent streaming charts.

Video Streaming overall

The chart below shows the percentage change in download speed from February 2020, on a daily basis. Higher values mean a faster download speed compared with February 2020. Results from all hours of the day are used (not just busy hours).

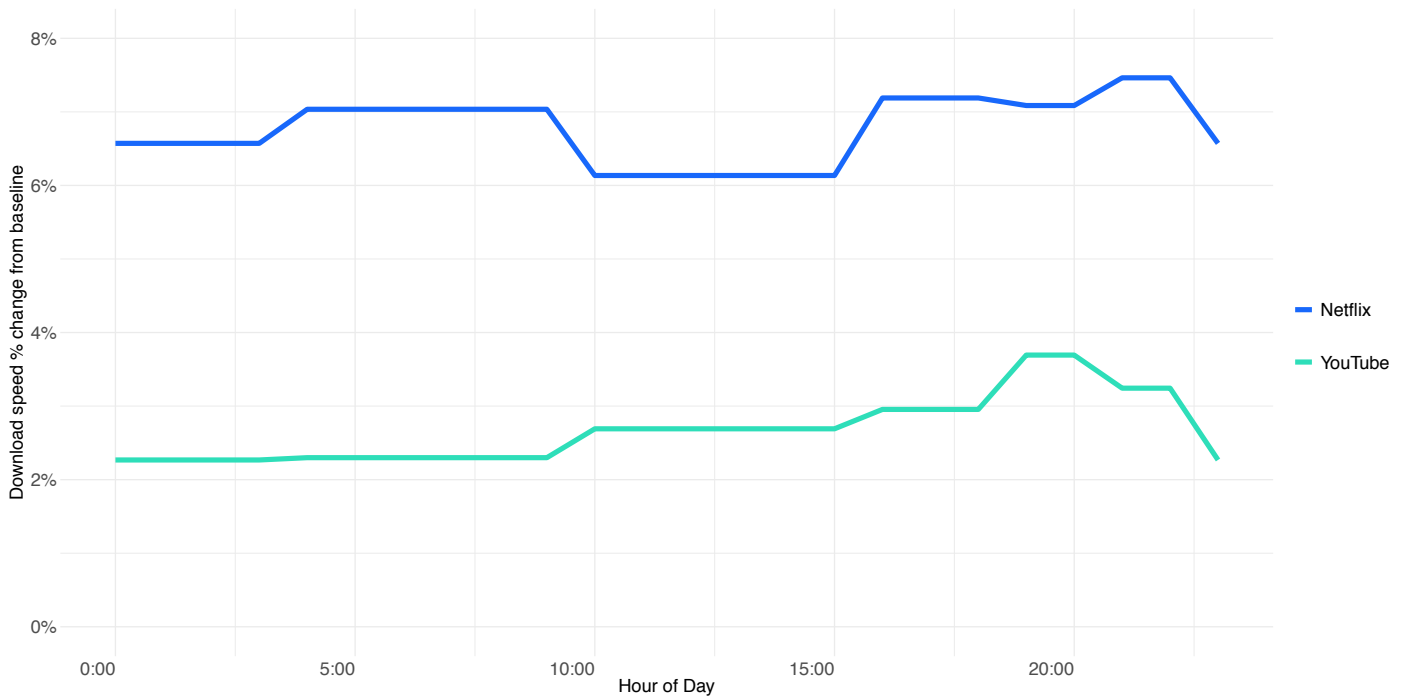


Key Observations

- Both streaming services performed above their February baselines for the duration of the reporting period. This is most likely due to the increase in the overprovisioning, as explained in the section above. This change was being implemented over the period between June and August 2020 and thus between the baseline in February and the reporting period we see a sustained increase in download performance. Both services also showed improved performance when compared to the first Critical Services Report which covered May 2020.
- Netflix saw a larger percentage point increase when compared to the February baseline, with its daily average performance being over 4% higher across the reporting period.
- YouTube also saw a sustained increase of at least 1% above the February baseline.
- Netflix's larger improvement suggests that by not capping download speeds, which is what YouTube does, the overprovisioning in download speeds can then more fully translate into an increased download speed for Netflix. This is unlike that which is possible for YouTube as they cap the download speed. Specifically, it suggests that YouTube limit the sending rate at their server side to be just faster than the bitrate of the video being streaming.
- The differences in performance are unlikely to be so significant that users would notice a discernible change in service quality.

Video Streaming by hour

The chart below shows the percentage change in download speed from February 2020, on an hourly basis. Higher values mean a faster download speed compared with February 2020. Results from all hours of the day are used (not just busy hours).

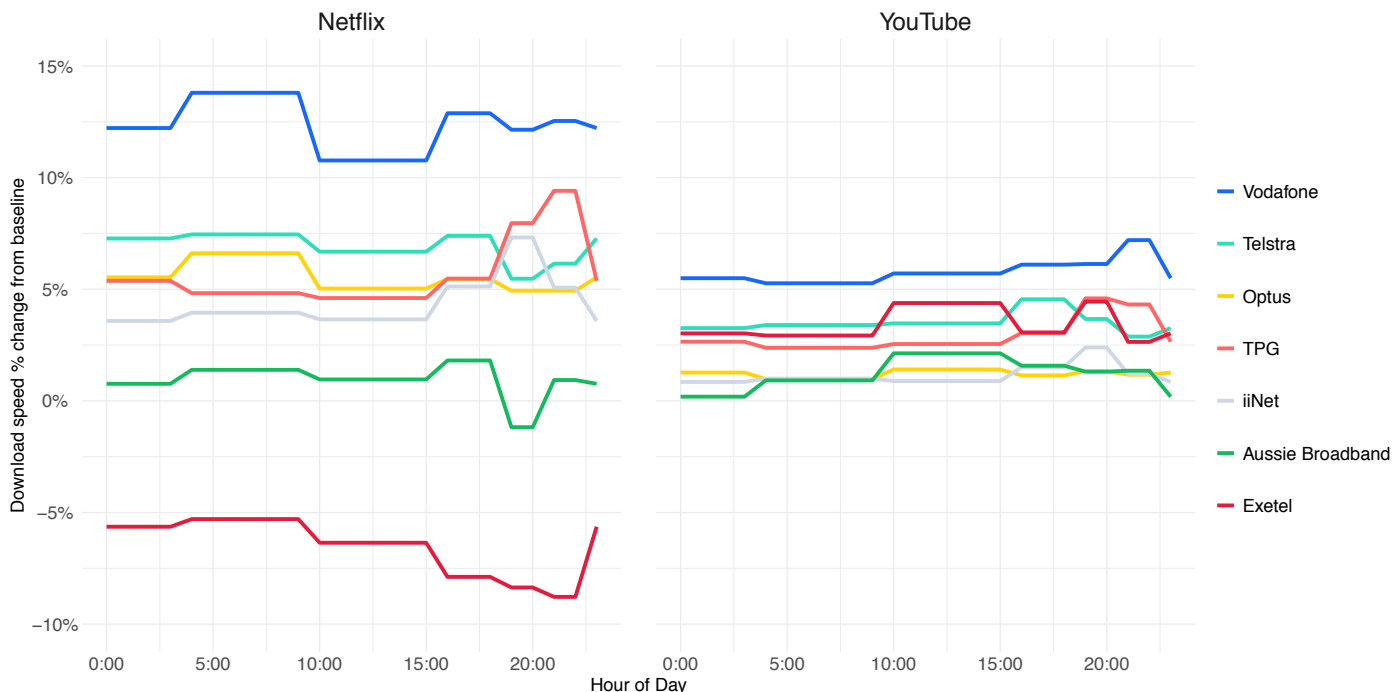


Key Observations

- When viewed on an hourly basis, it is again clear that both services have improved against their respective February baseline across all hours.
- Netflix outperforms its baseline by at least 6% across all hours. Its largest improvement comes in busy hours, at over 7%. The smallest improvement is seen in the time window from 10am to 3pm, which could suggest changes in usage patterns brought about by the COVID-19 pandemic have led to increased usage in this former non busy hour period.
- YouTube sees the highest improvement in performance during busy hours, where it performs above 3% better than its February baseline. It is likely that outside of busy hours most of the sampled Whiteboxes perform near the speed cap and thus have little capacity for improvement. Whereas during busy hours, the increased download speed from the change in provisioning in addition to the extra CVC capacity allows a larger increase compared to the baseline.

Video Streaming by RSP**

The chart below shows percentage change in download speed from February 2020, on an hourly basis. Positive results indicate improvement from the February 2020 baseline. Results from all hours of the day are used (not just busy hours). Each RSP's performance is compared to its own baseline performance.



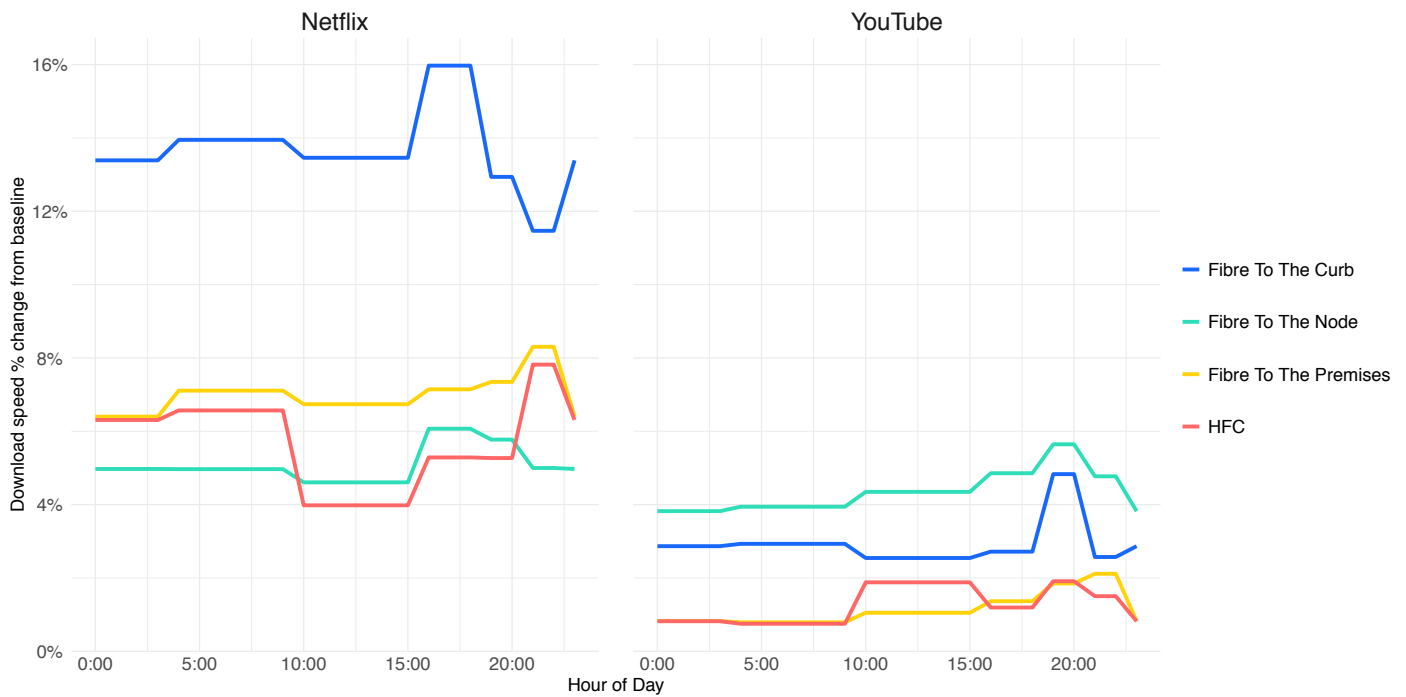
Key Observations

- The chart shows changes in RSP download speed performance between the test period (mid-September to mid-October 2020) and the baseline period (February 2020). The charts do not show RSP performance in absolute terms or relative to other RSPs.
- There is considerable variation in how each RSP performed compared to its baseline in February. It should be noted that many factors could impact these results and none suggest that any RSP has provided a poor service.
- For Netflix, the range of variation compared to February is between approximately -8% to +14%. RSPs show distinct intra-day performance with some performing better during busy hours compared to their baseline and some below that of their baseline.
- For YouTube, the extent of variation is lower, which is expected given YouTube cap download speeds. For YouTube, the pattern during the day is broadly consistent across all RSPs compared to their baseline.
- As reported in the first Critical Services Report, an issue with results for MyRepublic for February has meant that it was not possible to include results from this RSP. Results from MyRepublic have been excluded from all results.

**Superloop, MyRepublic, Dodo & iPrimus and smaller RSPs have been excluded from this chart

Video Streaming by access technology

The chart below shows percentage change in download speed from February 2020, by hour of day and access technology. Higher values mean a faster download speed compared with February 2020. Results from all hours of the day are used (not just busy hours).

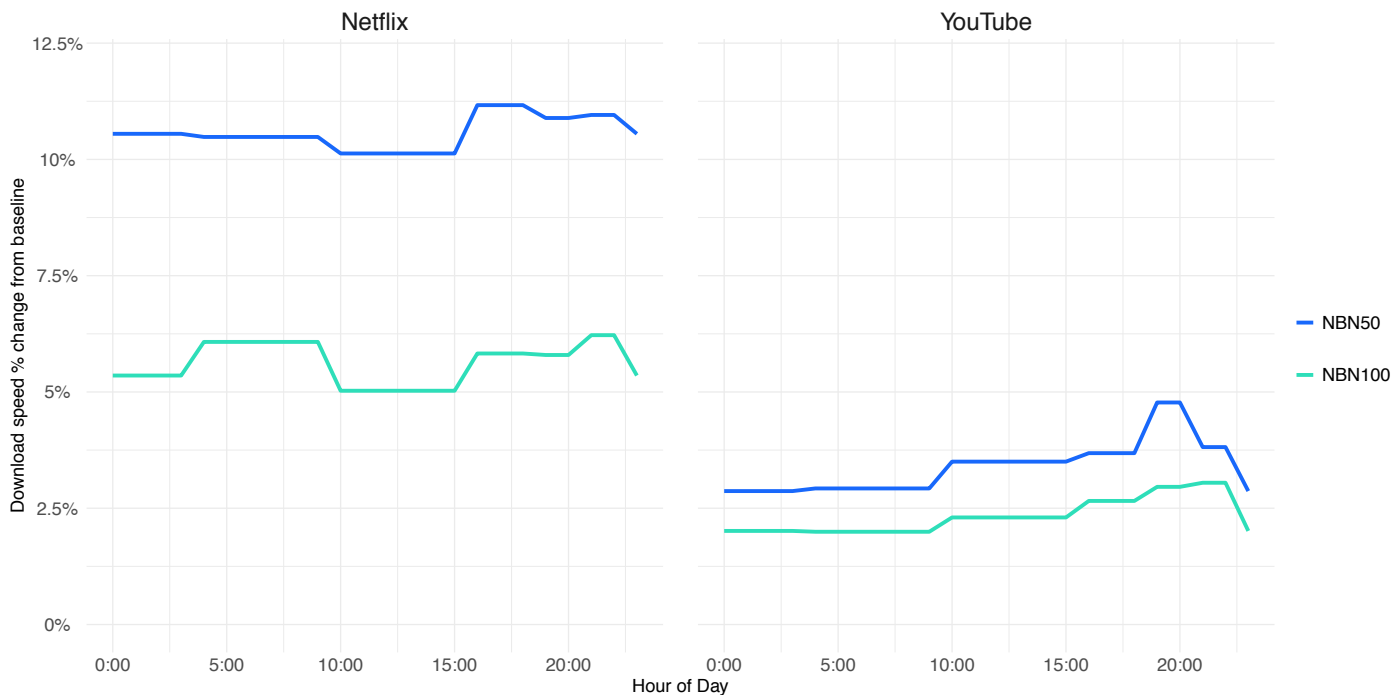


Key Observations

- The different access technologies are above their February respective baselines for both streaming services.
- The large increase for fibre to the curb services is likely in part an artefact of this access technology’s small sample as well as changes from the baseline.

Video Streaming by NBN plan***

The chart below shows percentage change in download speed from February 2020. Higher values mean a faster download speed compared with February 2020. Results from all hours of the day are used (not just busy hours).



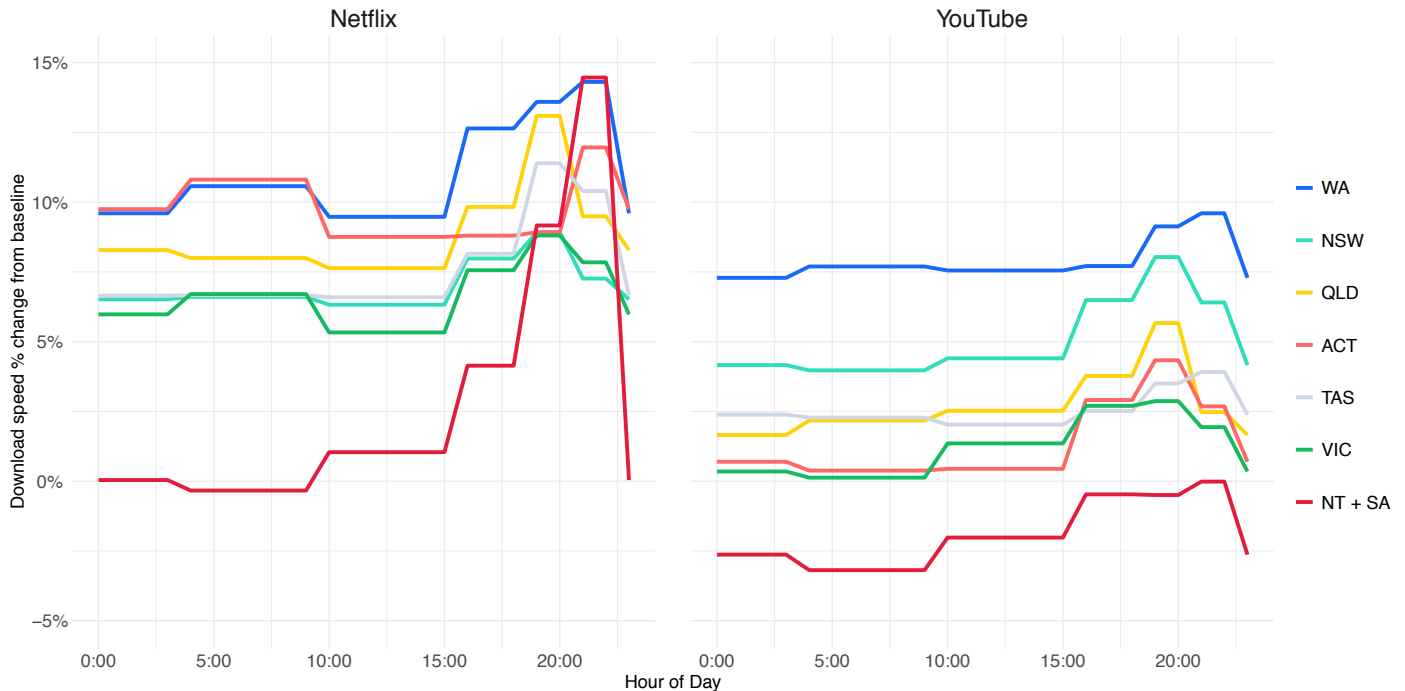
Key Observations

- As to be expected, the NBN plans monitored (NBN100 and NBN50) have download speeds above their February baselines for all hours of the day.
- For both services, the NBN50 plan showed a larger improvement against the baseline compared to the NBN100. This suggests the impact of the change in over-provisioning of download speeds and increased CVC capacity has had a larger impact on NBN50 plans.
- The increases seen for Netflix are larger, due again to the fact that Netflix do not cap download speeds. YouTube do cap speeds and thus it is more likely that NBN50 units would have room to increase up to the download limit, and so this also helps explain the NBN50's larger improvement for YouTube.

***25/5 and 12/1 plans are not included as test data for these plans was not recorded during the baseline period.

Video Streaming by State

The chart below shows percentage change in download speed from February 2020 for the states and territories. Positive results indicate improvement from the February 2020 baseline. Results from all hours of the day are used (not just busy hours).



Key Observations

- There is variation between how states and territories have performed compared to their February baselines. Most states and territories have shown an improvement for both streaming services.
- For Netflix, most states and territories show an average improvement from the baseline of between 4-10% across all hours. There is some intra-day variation, with improved busy hour performance compared against non-busy hours for Western Australia, Northern Territory and South Australia and the Australian Capital Territory.
- For YouTube, New South Wales and Western Australia show a larger improvement compared to their baselines than other states across all hours.

NBN Whiteboxes for streaming services

The total number of Whiteboxes included for different splits vary as certain subgroups were excluded due to containing insufficient units. The number of units varies between different services due to a different number of tests being completed and the subsequent impact of exclusion criteria.

Tier

Tier	Netflix	YouTube
50	519	519
100	333	332

Access Technology

Access Technology	Netflix	YouTube
Fibre to the curb	60	61
Fibre to the node	387	386
Fibre to the premises	244	246
HFC	161	158

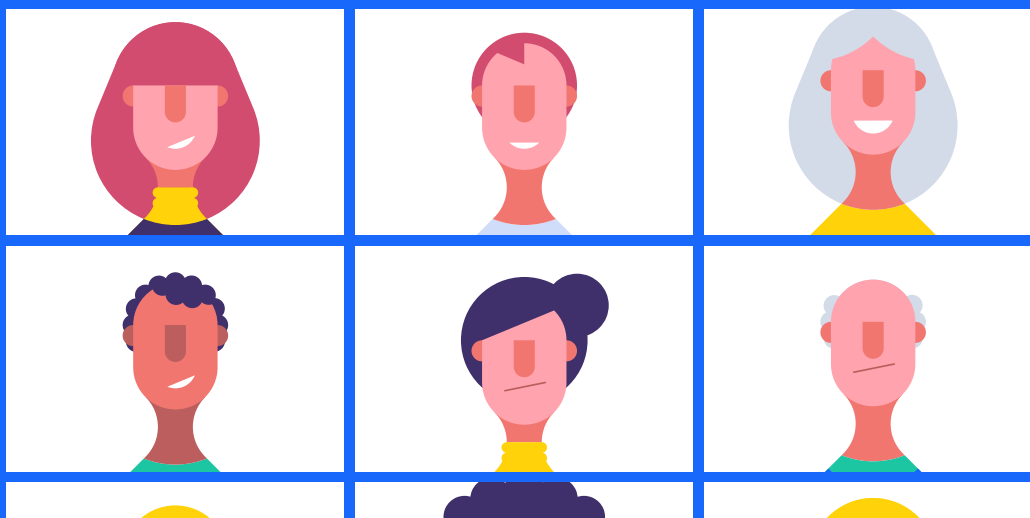
State

State	Netflix	YouTube
ACT	42	44
NSW	289	287
NT + SA	49	50
QLD	132	134
TAS	42	42
VIC	221	217
WA	77	77

RSP

RSP	Netflix	YouTube
Aussie Broadband	112	111
Exetel	64	64
iiNet	110	111
Optus	109	112
Telstra	152	151
TPG	112	111
Vodafone	59	62

Video Conferencing applications



This report looks at latency to video conferencing applications across RSPs, access technologies and NBN plan. All charts are for results to domestic servers unless otherwise stated.

As identified in the previous report SamKnows has worked with various video conferencing providers to identify subtleties in how these applications handle traffic and how this impacts customer experience. One of the factors that can affect performance is whether a call is placed using a free account versus a paid account. Research into these applications has shown that for certain services, calls made via a paid account will direct traffic to a different server than the free version of the service. Note this does not apply to all providers tested. Use of a paid account more often means that the application will use a domestically hosted server, although this is not always the case. Some of the providers presented use domestic servers for both free and paid accounts, others use international servers for free accounts and domestic ones for paid, one application provider appears to always use an international server for conferences initiated in Australia.

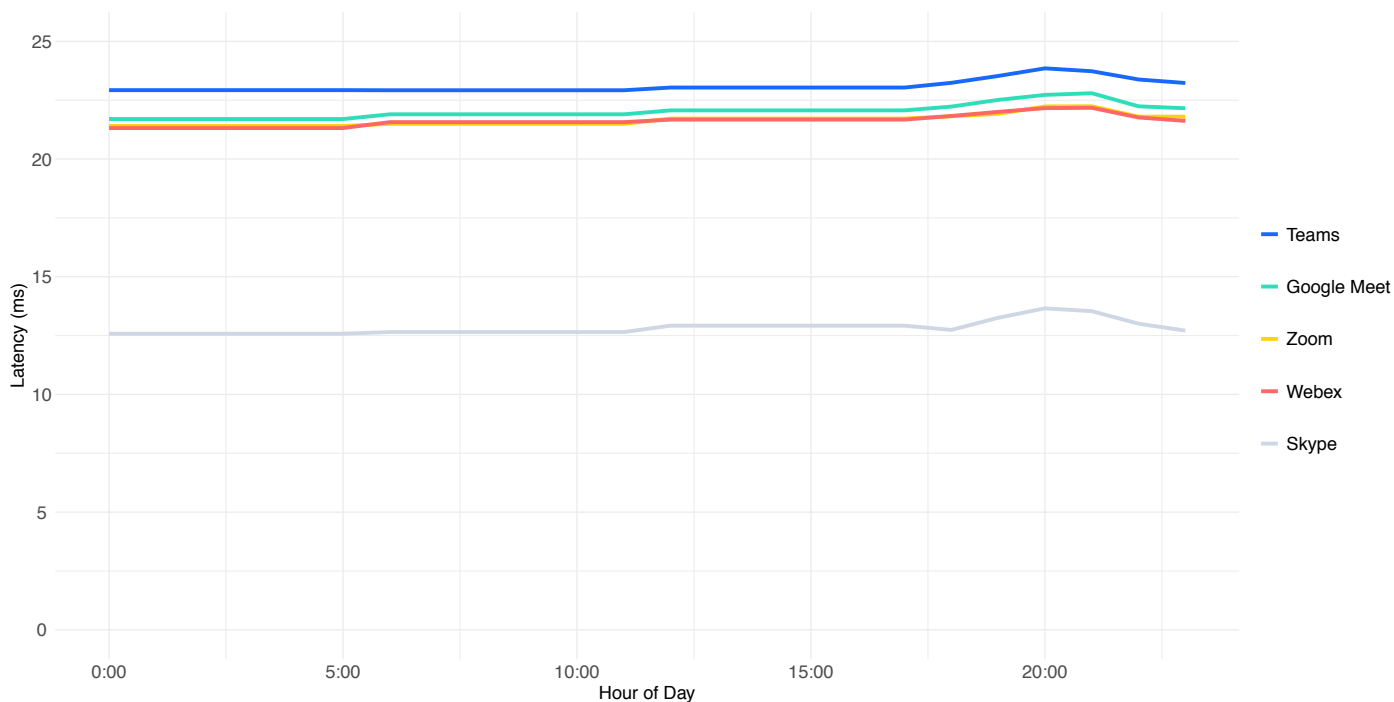
Due to this distinction SamKnows has rolled out enhancements to the original test and now collects measurements from both free and paid accounts where these are offered. As noted, additional factors may affect video conferencing and SamKnows is working to include additional metrics as part of this test.

The video conferencing test measures round trip latency. Latency is a suitable metric for assessing video conferencing performance as video conferencing is inherently a real-time application. Latency to the video conferencing server will be the dominant factor in how responsive the call feels (e.g. is there a lag or a delay?). Note that it is important to measure latency to the real conferencing servers of the various providers, and that is what the Whiteboxes do. Performance is measured using latency (ms). It should be further noted that network latency is just one factor that affects end user experience. For example, the use and efficiency of video compression will also have an impact on user experience but this has not been tested as part of this report.

Data is provided from 1st October to 15th October 2020.

Domestic Video Conferencing Applications by hour

The chart below shows latency to domestically hosted video conferencing application servers, split by hour of day. Lower latency generally leads to better perceived quality. Results from all hours of the day are used (not just busy hours).

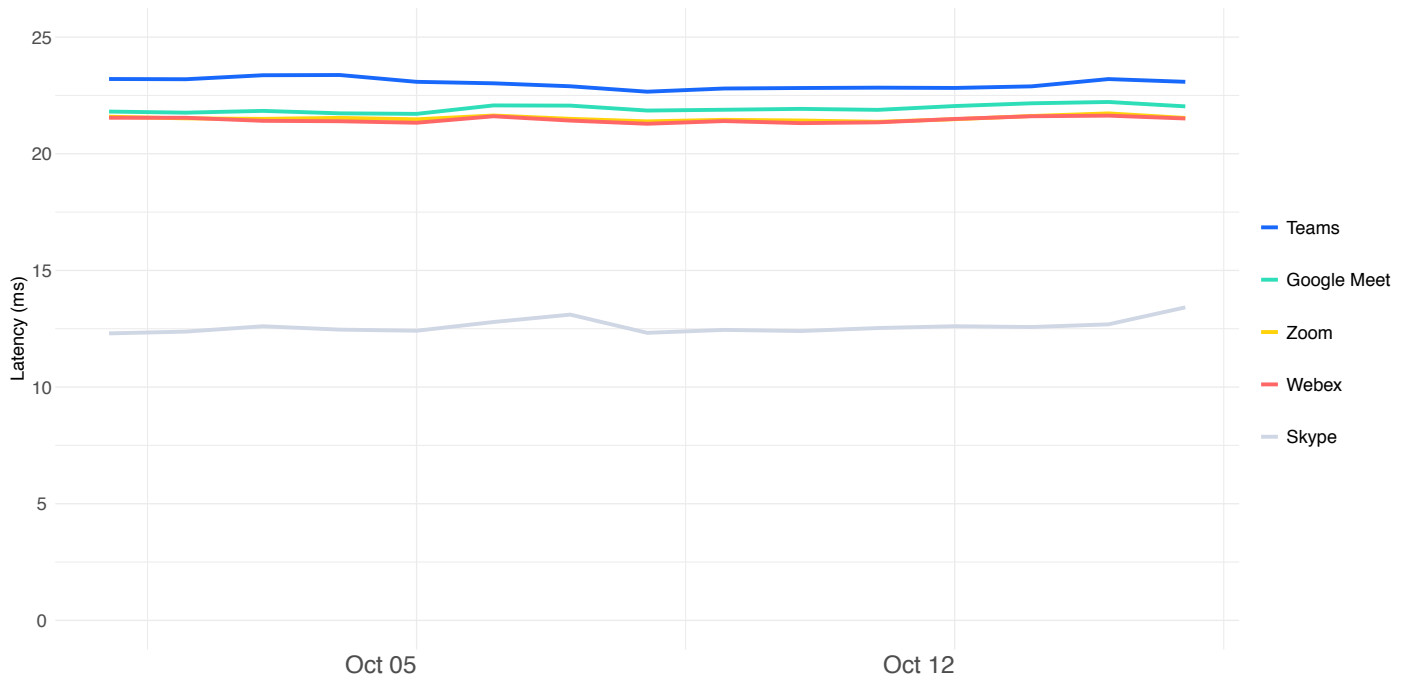


Key observations

- The most significant driver of latency is distance to the end server and observed latencies are lower for video conferences that are hosted on domestic servers.
- The addition of paid services to this report has meant that the number of domestic video conferencing applications monitored has increased to five from the three featured in the previous report. Zoom and Webex have been added since the first Critical Services Report.
- The low latency observations indicate that good quality access was available to the video conferencing applications hosted on domestic servers.
- The results of the applications featured in the first Critical Services Report are consistent between both reports.
- Skype consistently displays the lowest latency of the applications that were tested for reporting on video conferences hosted on domestic servers. That said, all services have low latency and the differences would not be noticeable.
- The applications exhibited here show marginally higher latency during the afternoon and evening. The increase is very slight and not sufficient to impact end user experience.

Domestic Video Conferencing Applications by day

The chart below shows latency to domestically hosted video conferencing application servers by day. Lower latency generally leads to better perceived quality. Results from all hours of the day are used (not just busy hours).

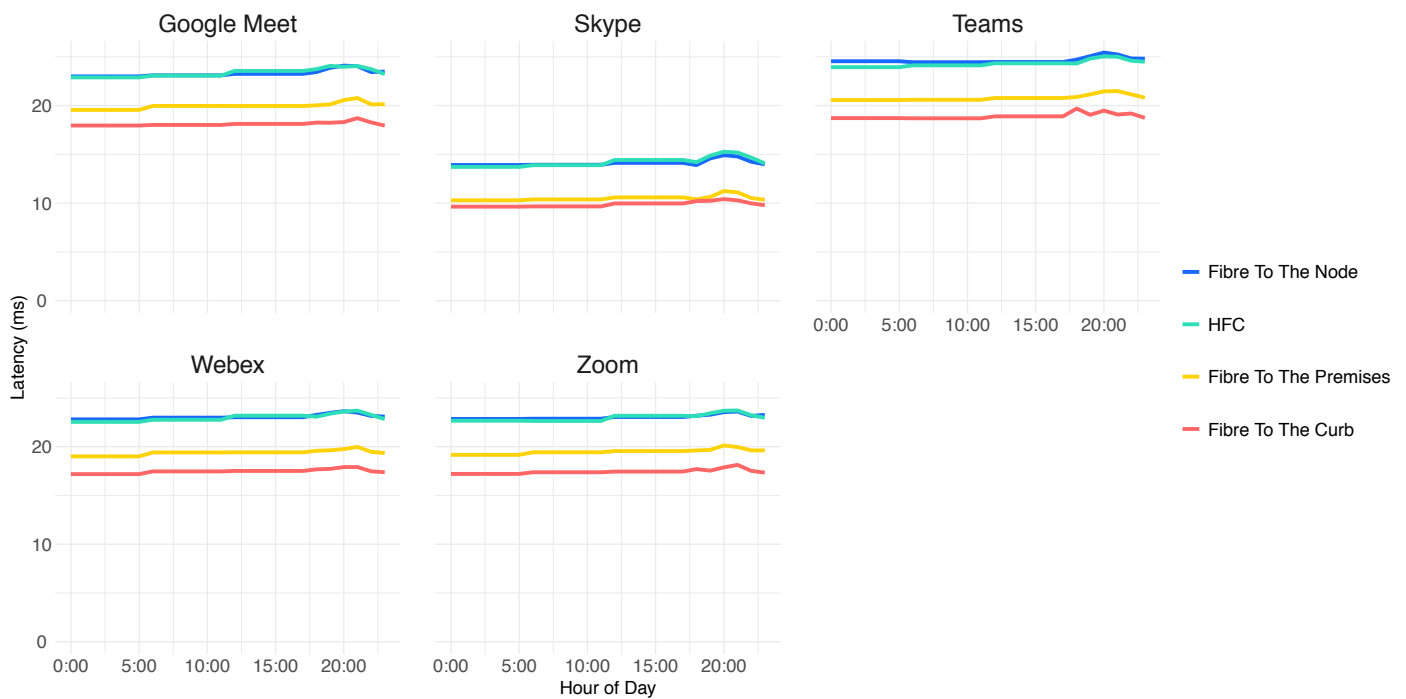


Key Observations

- Much like the first Critical Services Report, the majority of applications show consistent daily average latency during the measurement period.
- These applications results show that they are generally very stable in terms of latency across the monitoring period and an end user should not expect variation in performance on different days.
- As stated previously these latency differences will not impact an end user.

Domestic Video Conferencing Applications by Access Technology

The chart below shows latency to domestically hosted video conferencing application servers by hour of day. Lower latency generally leads to better perceived quality. Results from all hours of the day are used (not just busy hours).

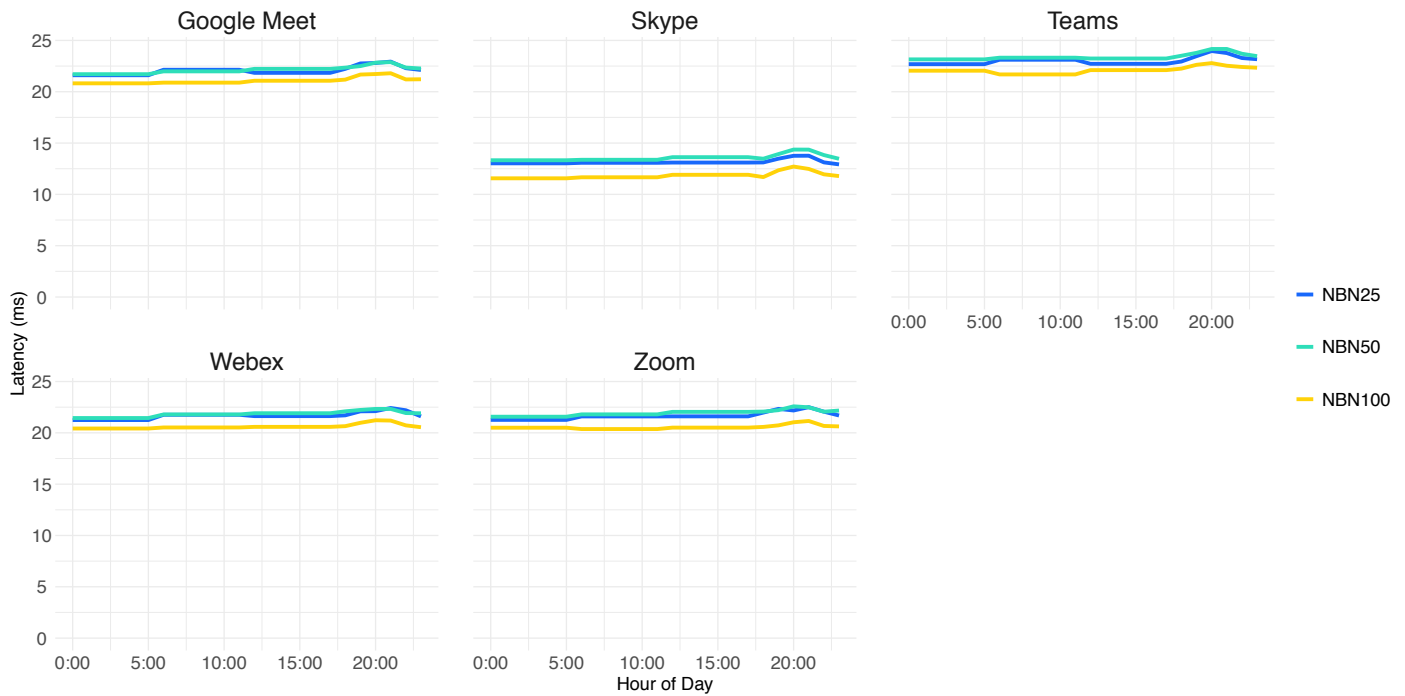


Key Observations

- As shown in the first video conference tracking report, the impact of access technology is small for video conferences that use domestic servers.
- These differences will not be noticeable to end users when using video conference applications.

Domestic Video Conferencing Applications by NBN Plan (NBN25, NBN50 and NBN 100)

The chart below shows latency to domestically hosted video conferencing application servers by hour of day. Lower latency generally leads to better perceived quality. Results from all hours of the day are used (not just busy hours).

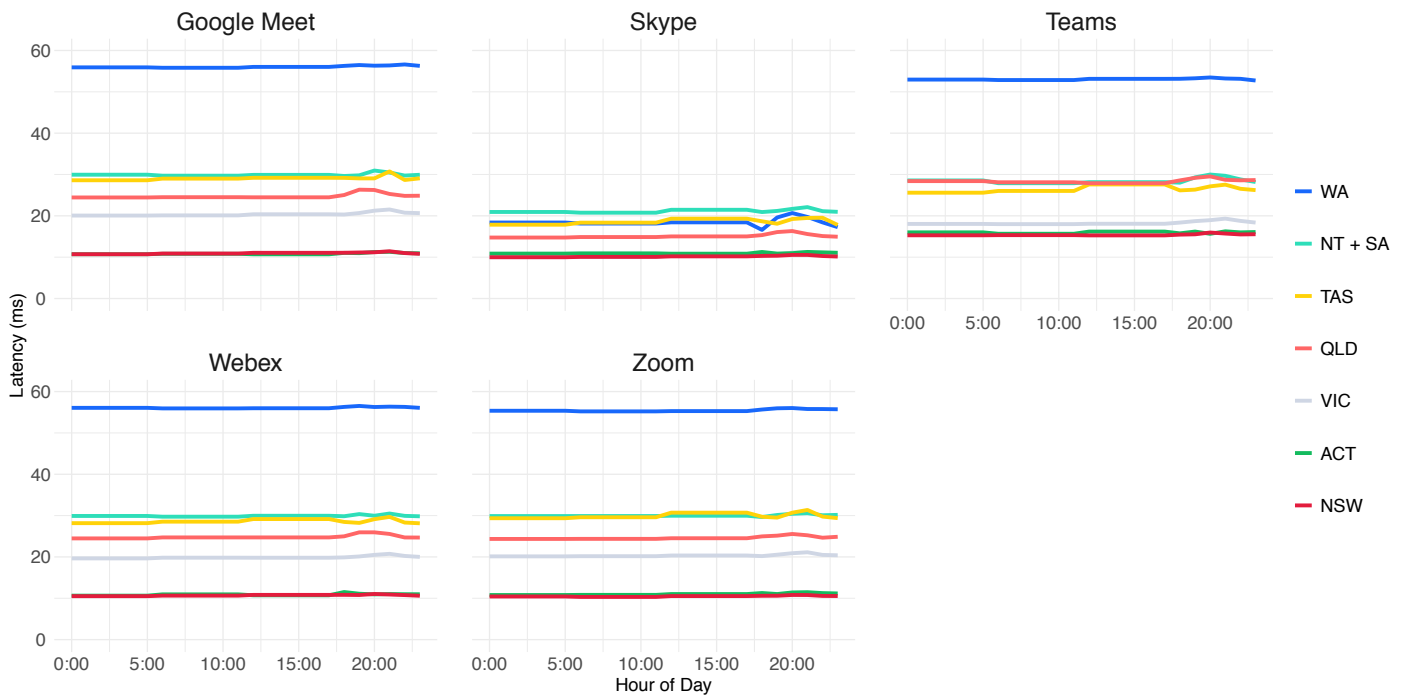


Key Observations

- The choice between NBN 25, NBN 50 and NBN 100 plans does not have a material impact on latency to video conferencing applications.
- An end user should not expect their choice of these analysed NBN plans to affect the latency measures of their chosen video conferencing application.

Domestic Video Conferencing Applications by State

The chart below shows latency to domestically hosted video conferencing application servers by hour of day. Lower latency generally leads to better perceived quality. Results from all hours of the day are used (not just busy hours).

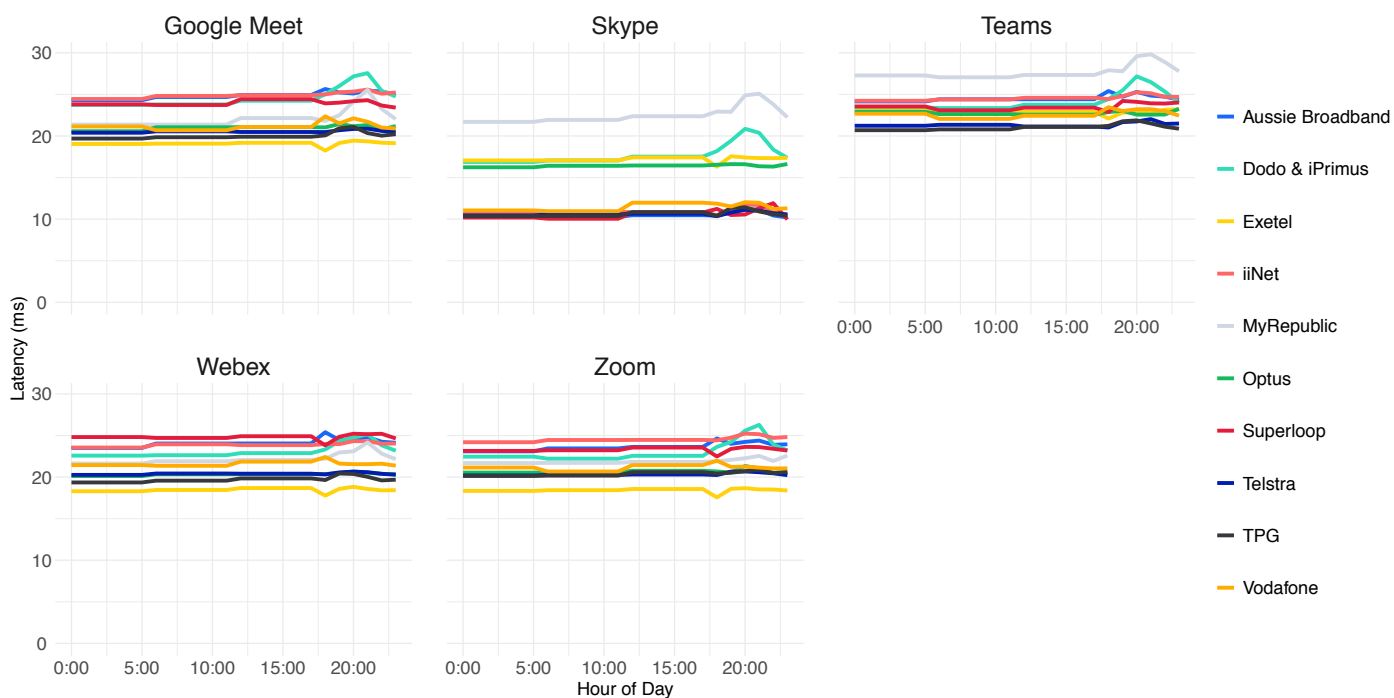


Key Observations

- As previously stated, physical distance causes the bulk of the impact on video conference application latency. Therefore some variation between states and territories is to be expected.
- The exact breakdown of which state has lower latency for which application will be determined by the exact routing used by the particular application.
- The charts show that Western Australia has the highest latency for all applications except for Skype, which suggests that traffic from this region on average has the furthest to travel for those applications.
- New South Wales and the Australian Capital Territory record the lowest latency scores.
- The differences shown will not have a noticeable impact on end user experiences.

Domestic Video Conferencing Applications by RSP

The chart below shows latency to domestically hosted video conferencing application servers by hour of day. Lower latency generally leads to better perceived quality. Results from all hours of the day are used (not just busy hours).

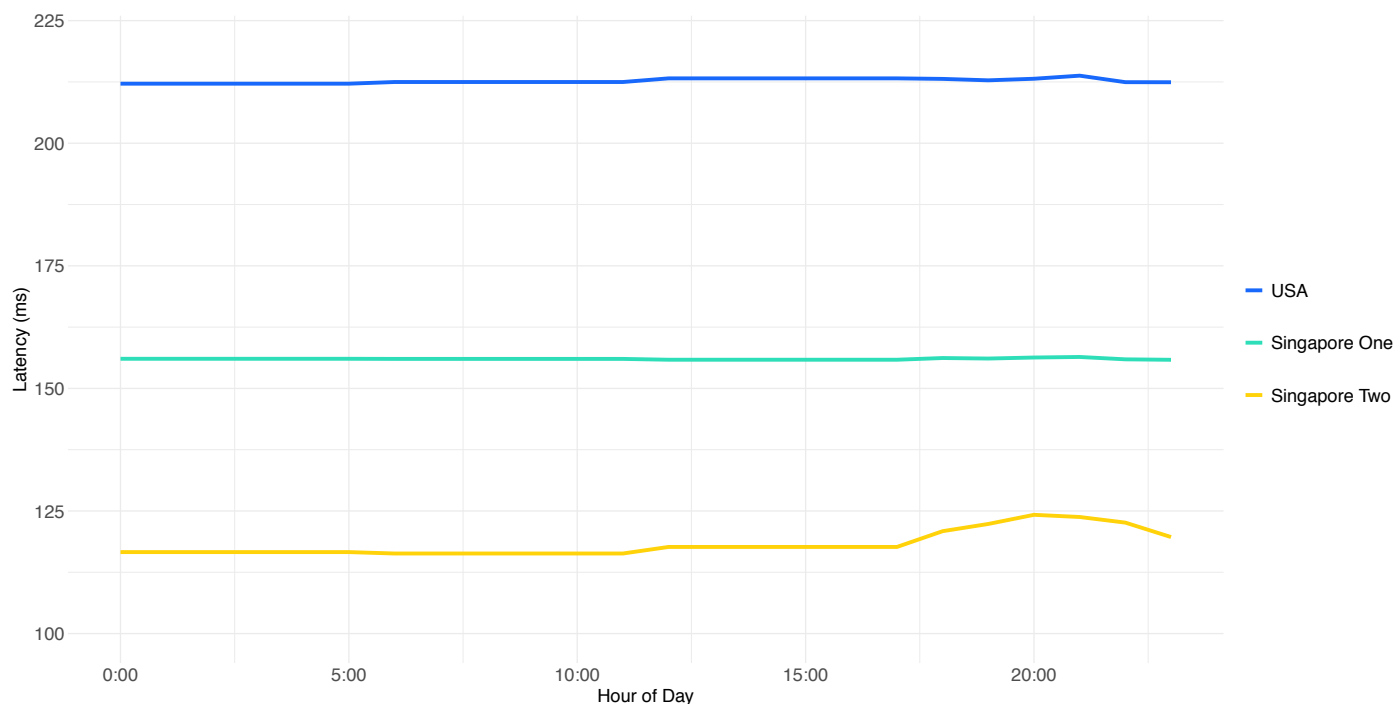


Key Observations

- The results for different RSPs are all broadly similar for the domestic video conferencing applications shown. The spread of results is around 10ms, which is an amount that would not be noticeable to the end user.
- The cause of the variation could as much be the geographic distribution of each RSPs Whiteboxes across Australia. That said, all services have low latency and the differences would not be noticeable to the user.
- A number of providers do show a little more tendency towards an increase in latency during busy hours. This increase is small and will not have an impact on end users.

International Video Conferencing Applications by hour

The chart below shows latency to internationally hosted video conferencing application servers by hour of day. Lower latency generally leads to better perceived quality. Results from all hours of the day are used (not just busy hours).

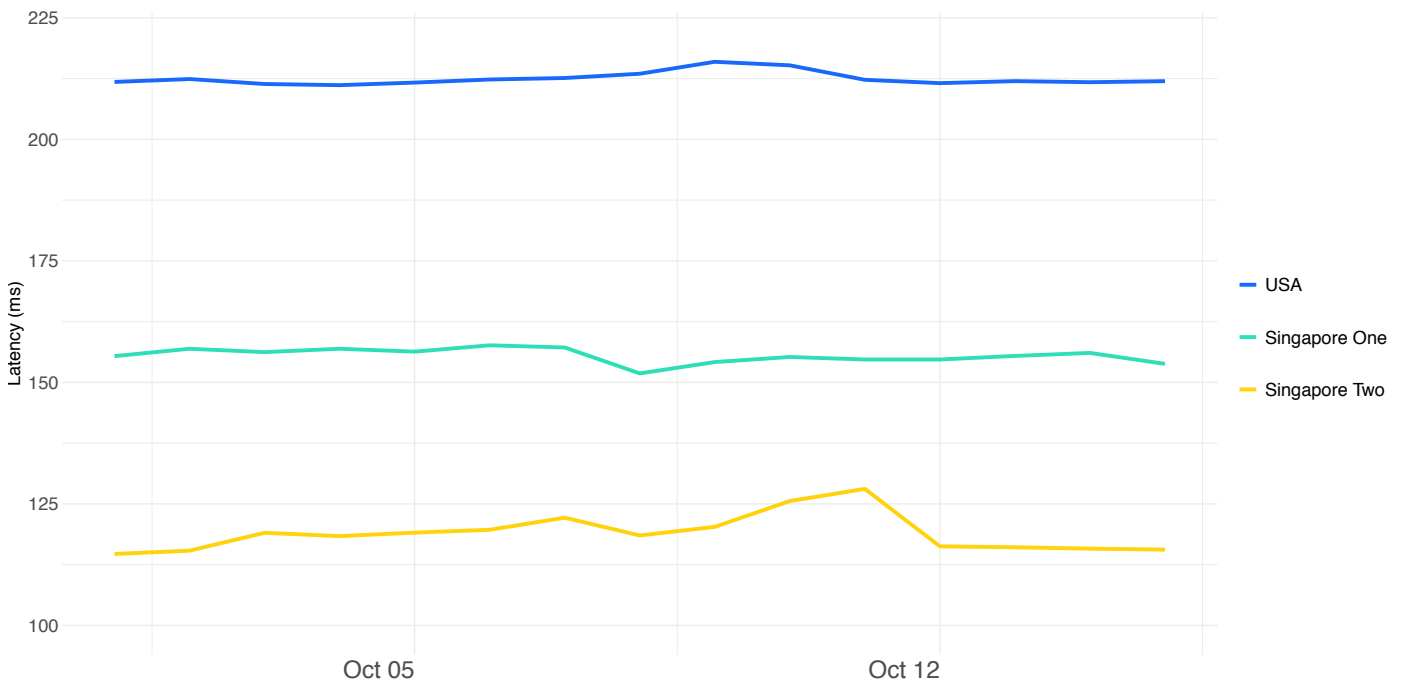


Key Observations

- International servers are included in this report as they can potentially be used by video conferencing applications in some cases even where the conference and user are located in Australia. This report features an application which uses servers in the United States and two which use servers based in Singapore.
- Video conferences that use international servers have higher latency due to the large return distances involved.
- All of the locations exhibited here show marginally higher latency during busy hours. The increase is very slight and not sufficient to impact on end user experience.
- The difference observed between the two Singapore based servers demonstrates how routing as well as server location can affect latency to video conferencing applications.
- While users would still be unlikely to notice a significant difference in performance for a video conference hosted on an international server, the increased latencies would produce a small lag that may lead to people accidentally talking over one another.

International Video Conferencing by day

The chart below shows latency to internationally hosted video conferencing application servers by day. Lower latency generally leads to better perceived quality. Results from all hours of the day are used (not just busy hours).

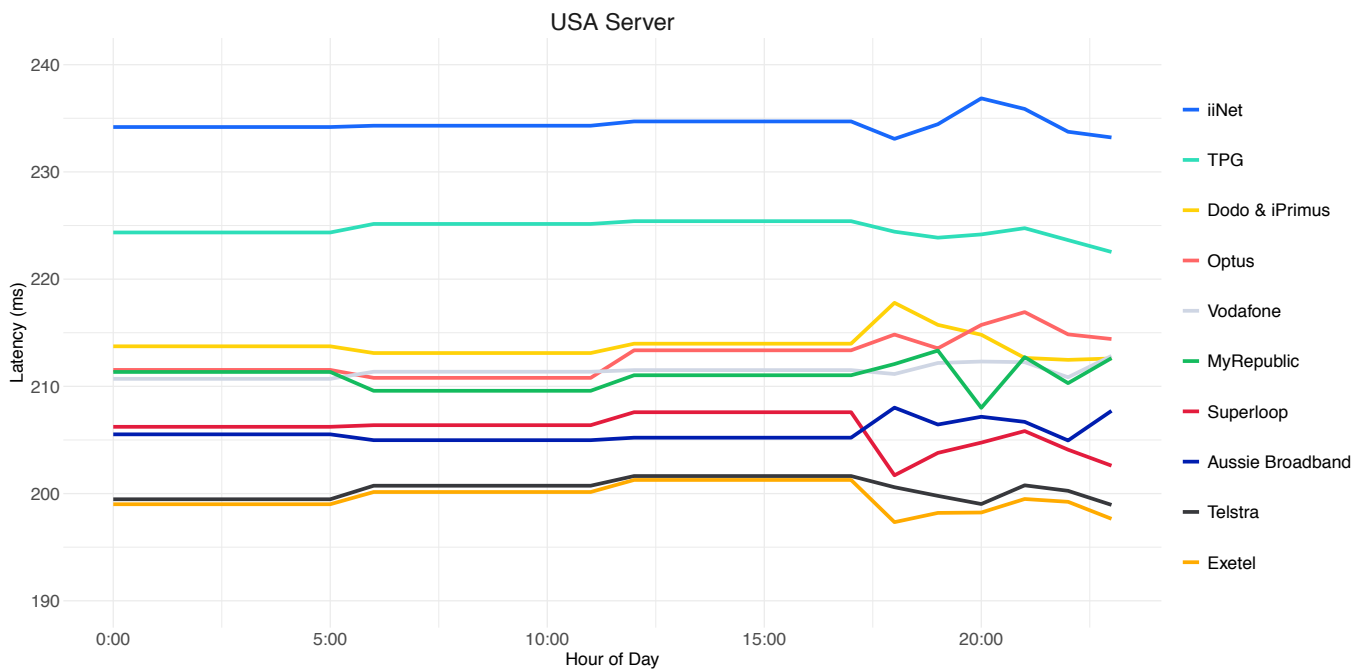


Key Observations

- The majority of locations show consistent daily average latency during the measurement period with the differences observed unlikely to have an impact on user experience.

Hourly performance to USA server by RSP

The chart below shows latency to a USA hosted video conferencing application servers by hour of day. Lower latency generally leads to better perceived quality. Results from all hours of the day are used (not busy hours).

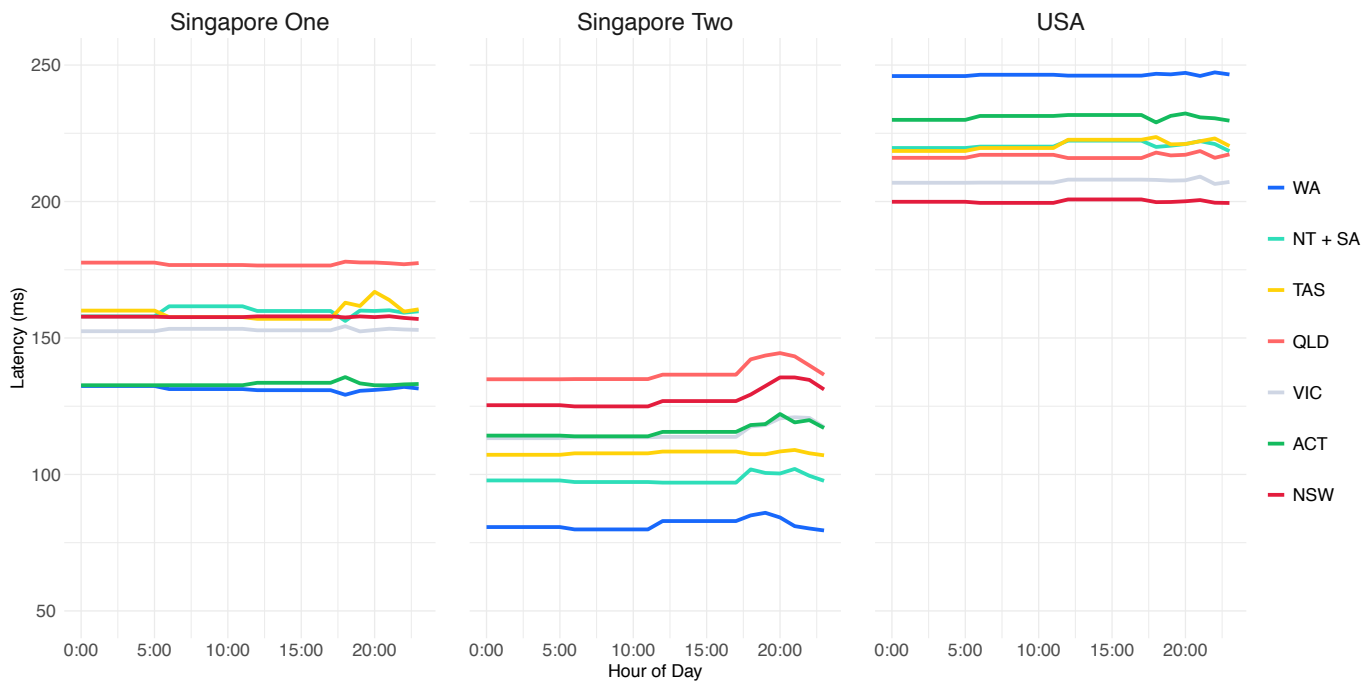


Key Observations

- The USA based server had the highest overall latency of the international server locations tested.
- On a split by RSP it is clear that different RSPs connect to the location in diverse ways and this leads to variation in latency.
- These variations are unlikely to have a significant impact on user experience when using the application.

International Video Conferencing by state

The chart below shows latency to internationally hosted video conferencing application servers by hour of day. Lower latency generally leads to better perceived quality. Results from all hours of the day are used (not just busy hours).



Key Observations

- For video conferences that use international servers, the difference in latency reflects the distance between the state and the server location.
- When Singapore is the server location, Western Australia has the lowest latency.
- The converse is true when the server is located in the United States. Here the East Coast states have lower latencies than Western Australia.

NBN Whiteboxes for video conferencing services

The total number of whiteboxes included for different splits vary as certain subgroups were excluded for containing insufficient units. The number of units varies between different services due to a different number of tests being completed and the subsequent impact of exclusion criteria.

Tier

Tier	Teams	Webex	Skype	Google Meet	Zoom	Singapore 1	Singapore 2	USA
NBN25	91	91	91	87	91	91	91	91
NBN50	531	532	534	499	534	532	532	534
NBN100	362	362	363	319	362	362	361	361

Access Technology

Access Technology	Teams	Webex	Skype	Google Meet	Zoom	Singapore 1	Singapore 2	USA
Fibre To The Curb	76	75	76	66	75	75	75	75
Fibre To The Node	486	487	489	458	489	487	486	489
Fibre To The Premises	278	279	279	254	279	279	279	279
HFC	191	191	191	171	191	191	191	190

State

State	Teams	Webex	Skype	Google Meet	Zoom	Singapore 1	Singapore 2	USA
ACT	52	52	52	42	52	52	52	52
NSW	345	345	346	319	346	345	344	346
NT + SA	62	62	62	57	62	62	62	62
QLD	167	166	168	152	166	166	166	167
TAS	42	42	42	41	42	42	42	42
VIC	263	264	264	241	264	264	264	263
WA	100	101	101	97	102	101	101	101

RSP

RSP	Teams	Webex	Skype	Google Meet	Zoom	Singapore 1	Singapore 2	USA
Aussie Broadband	163	163	164	149	163	163	162	163
Dodo & iPrimus	38	38	39	33	38	38	38	39
Exetel	66	67	67	62	67	67	67	67
iiNet	129	129	129	120	129	129	129	129

MyRepublic	58	58	58	54	59	58	58	58
Optus	117	119	119	104	119	119	119	119
Superloop	35	35	35	29	35	35	35	35
Telstra	181	181	181	175	181	181	181	181
TPG	155	153	154	140	154	153	153	154
Vodafone	69	69	69	66	69	69	69	69